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EFFICIENT IMPLEMENTATION OF WATERMARKING TO REDUCE BIT ERROR RATE

Jyoti*, Er. Shilpa Jain
* Student, CSE, JCDM College of Engineering, Sirsa, India.
Asst Professor, CSE, JCDM College of Engineering, Sirsa, India.

ABSTRACT

Digital watermarking is a term to describe inserting data invisibly within a host sound, image or video file in order to prove ownership. Over the past decade many watermarking techniques have been proposed to make this possible. Any such mark should still be detectable after common processing operations, including lossy file compression. Various audio watermarking techniques representative of this work will be implementing against many sound processing operations which may or may not remove the watermark. The individual strengths and weaknesses will be analysed. In proposed work, the algorithm should be able to add more data with less BER (Bit Error Rate).

KEYWORDS: BER (Bit Error Rate), PSNR (Peak Signal To Noise Ratio), MSE (Mean Square Error), DCT (Discrete Cosine Transformation).

INTRODUCTION

Digital audio watermarking schemes currently are the most interesting and popular research area for copyright protection of the multimedia data, where a lot of work has been done and is still being developed for finding more improved method to enhance the security, robustness and quality of watermark data. A variety of procedures have been used to appropriate watermarks to the audio indicators three requirements which are indispensable for any audio watermarking format is: Inaudibility, Robustness and data rate. Inaudibility indicates that implantation should be performing in such a way that there is a slight difference sandwiched between inventive signal and watermarked indicator. Therefore, inaudibility is extra imperative metric than the others for any audio watermarking scheme. Other desires, that is, robustness and data rate are also important but these two cannot be accomplish at the same point in time to function as a constructive and steadfast rational belongings protection technology, the watermark

- Must be embedded within the host media
- Perceptually inaudible inside the mediums
- Statistically indemonstrable to make certain safety measures and thwart unconstitutional subtraction
- Full-bodied to management and signal dispensation operation on the host indication, e.g. noise, firmness, cropping, resizing, D/A conversions, etc.
- Willingly haul out to utterly differentiate the official document owner.

Basically, the watermark possibly will not be accumulated in a ple header and separate ple. Those kind of copyright methods are straightforwardly separated. The watermark must be muffled surrounded by the congregation audio data to keep up audio quality. The watermark is required to be statistically untraceable to spoil unofficial amputation by machinist. A watermark which possibly will be restricted through averaging, correlation, spectral analysis, Kalman filtering, etc., may perhaps be voluntarily removed or changed. Digital watermarking being capable of be alienated into image watermarking, video watermarking, audio watermarking, and text watermarking and graphic watermarking supported on the close media. Image watermarking can be stated as to adjoining of watermark in motionless image. Video watermarking appends digital watermark in the video brook to organize video purposes. Text watermarking is the way of affixing watermark to PDF, DOC and other text file to avoid alterations of text. Graphic watermarking is implant watermark to two-dimensional or three-dimensional computer-produced graphics to point towards the copyright.

PROPOSED METHODOLOGY

There are different methods for watermark the information in media file and this research has been considered the audio file. The methods should reduce the BER (Bit Error Rate). After watermark information and more information should be added in that particular file.

a. Study the Watermarking Concept in multimedia and analyze the watermarking techniques.
b. Study the steps of existing algorithms such as DWT and DCT.
c. Research on these Techniques for identification of issues.
d. Apply wavread, wavwrite, wavplay function to read and work with Audio Frames.
e. Implement LSB (Least Significant bit) watermarking Technique & Filtration based Watermark to the information.
f. Flow development of new proposed DCT technique on text image & text to reduce bit error rate.
g. Implementation using MATLAB Tool.
h. Generate Results.

PRELIMINARIES

Matrix Generation

The transpose $\mathbf{A}^T$ of a matrix **A** can be obtained by reflecting the element along its main diagonal. Re-applying the process on this transposed matrix generate the element to their original position.
Example of 3-by-3 matrix is shown which take input "jyoti" and output is shown in the given figure. In result the row and column index for each element are interchanged.

Example

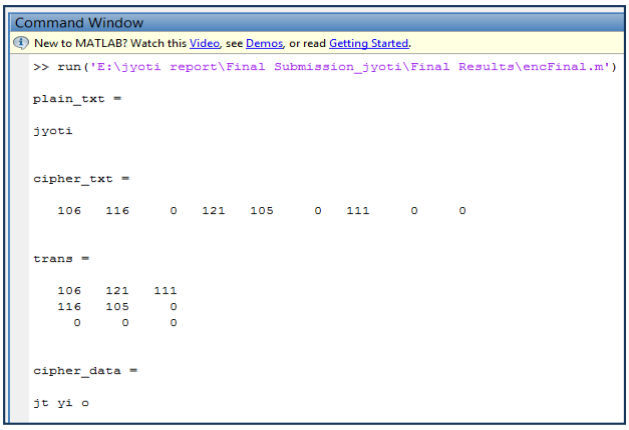


Fig1: Matrix generation

DCT

A discrete cosine transform DCT is a very popular transform function used in signal processing. It transforms a signal from spatial domain to frequency domain. Due to good performance, it use in Audio watermarking.DCT expression

$$y(k) = w(k)\sum_{n=1}^{N} x(n)\cos\left(\frac{\pi}{2N}(2n-1)(k-1)\right), \quad k = 1, 2, \ldots, N,$$

y = dct(x) returns the unitary discrete cosine transform of x,
N is the length of x, and x and y are the same size. If x is a matrix, dct transforms its columns. The series is indexed from $n = 1$ and $k = 1$ instead of the usual $n = 0$ and $k = 0$ because MATLAB® vectors run from 1 to *N* instead of from 0 to $N - 1$.

Mean Squared Error (MSE)

MSE is an error performance function .Which measure the performance according to mean square error. In digital watermarking the MSE Calculate the error between the original signal and Watermarked signal.MSE is a risk function, corresponding to the expected value of the squared error loss or Quadrate loss.MSE measures the average of the

"error" .the error is the amount by which the value implied by the estimator differs from the quantity to be estimated. Value of MSE is given by:

$$MSE = \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{n-2}$$

Where y_i is the watermarked audio and $y_i^{\wedge}$ is original audio. n is no. of samples.

A. Peak Signal to Noise Ratio (PSNR)

The PSNR measure is widely used for evaluation of perceptual quality of audio watermarking algorithm, because of its simplicity. PSNR gives the difference between the original and the watermarked audio signal in decibels. Signal to noise ratio is a parameter used to know the amount by which the signal is corrupted by the noise. it is defined as the ratio of the signal power to the noise power.

The value of SNR is given by:

PSNR = 20* log10 (MAXVAL/MSE);

B. Bit Error Rate (BER)

Bit error rate is a key parameter that is used when transmits digital data from one location to another. It calculates how much bits are disturbed during transmission by the effect of noise.

The error calculated by BER is given by:

$$\text{BER(Bit Error Rate)} = \frac{\text{Number of bits received in error}}{\text{Total number of bits transmitted}}$$

EXPERIMENTAL RESULTS

During experimentation, different audio files were used for embedding watermark. All the audio files we took were of size more than 10sec. To analyse the performance of the proposed algorithm parameters (MSE, PSNR, and BER) were used and evaluated.

Implementation of Text watermarking

Audio file:- Rani.wav
Input:-Inserting watermark in audio
Text Watermark: - jyoti

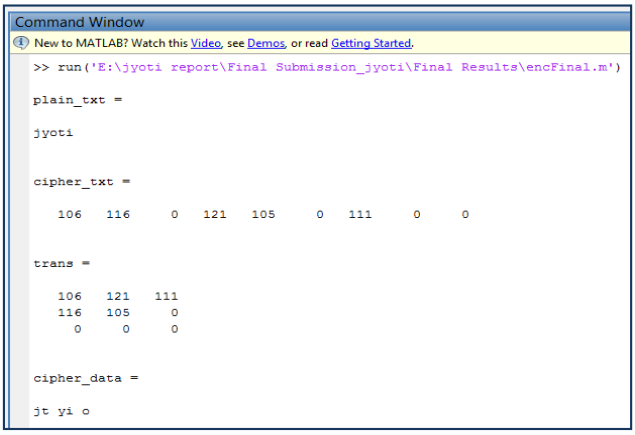


Fig 2: Inserting watermark in audio

Before and after watermark Graph

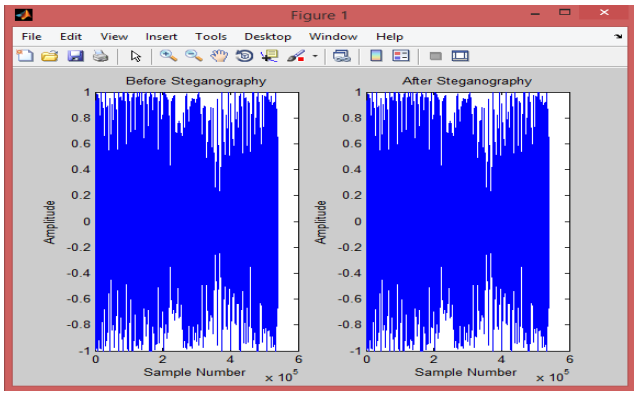


Fig 3: Before and after watermark Graph

Watermark output

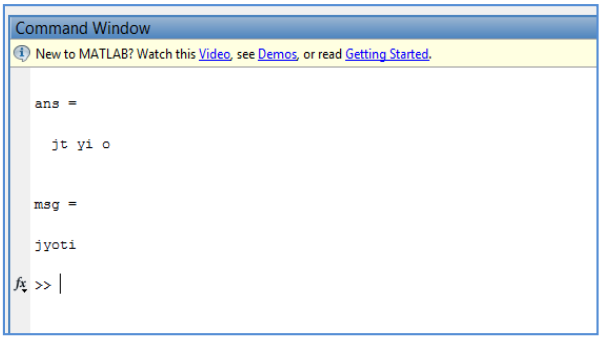


Fig 4: Watermark output

Error rate values

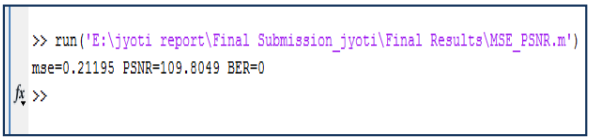


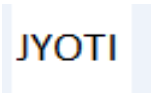
Fig 5: Error rate value

Implementation of Image watermarking

Audio file:-Rani.wav

Input:-Inserting watermark in audio

Image watermark:-



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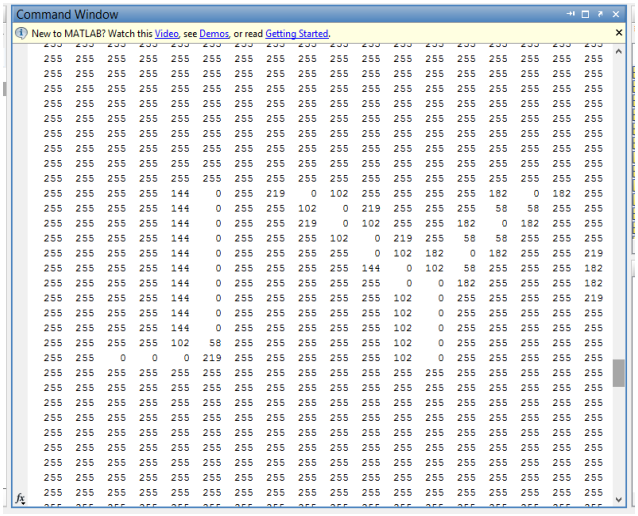


Fig 6: Inserting watermark in audio

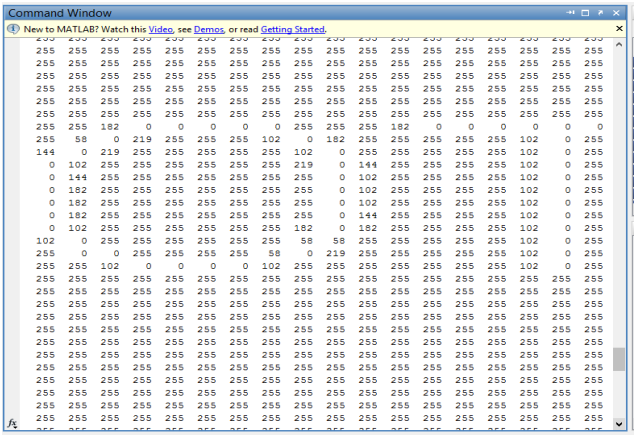


Fig 7: Inserting watermark in audio

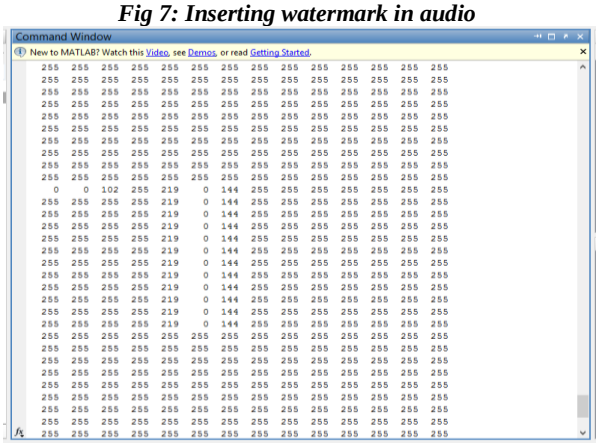


Fig 8: Inserting watermark in audio

Before and after watermarking graph

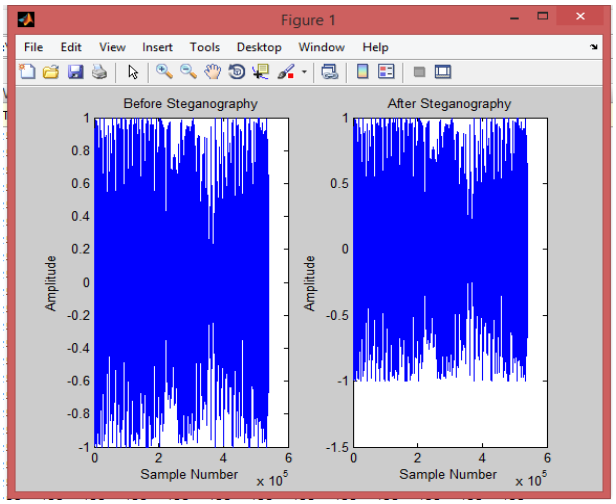


Fig 9: Before and after watermarking graph

Extraction of watermark

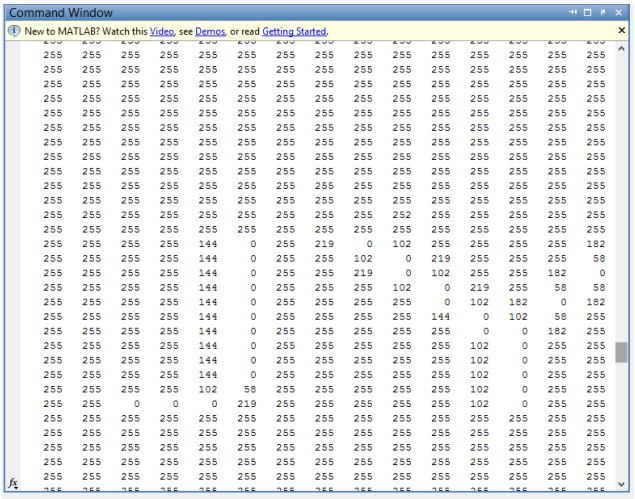


Fig10: Extraction of watermark

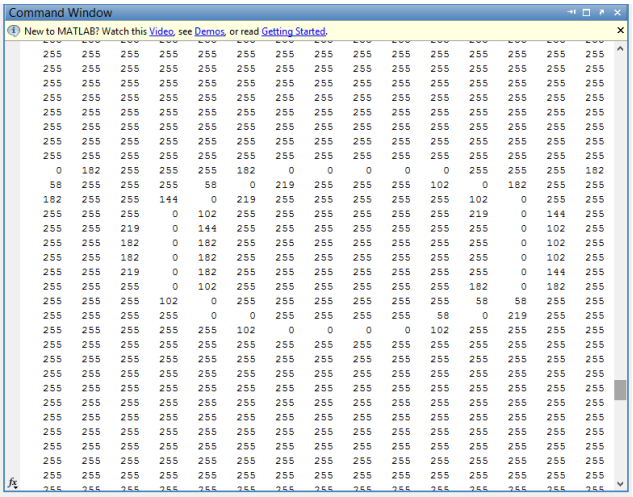


Fig11: Extraction of watermark

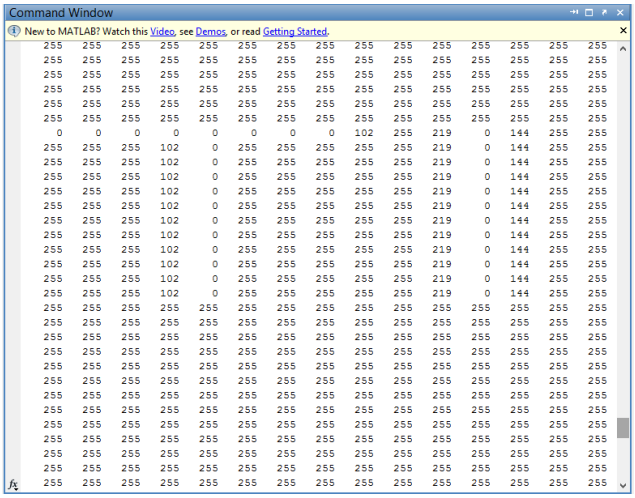


Fig12: Extraction of watermark

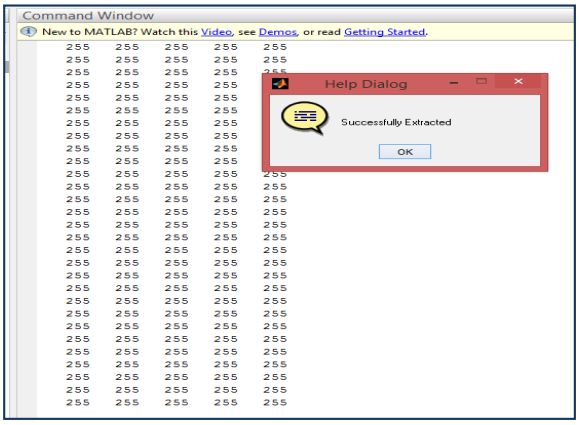


Fig13: Extraction of watermark

Output file After Extraction

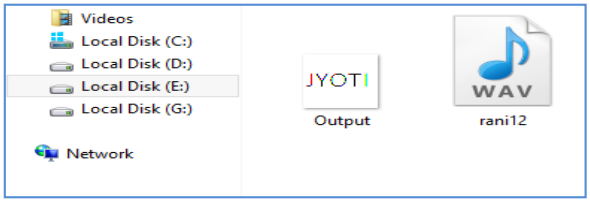


Fig14: Output file After Extraction

Error rate values

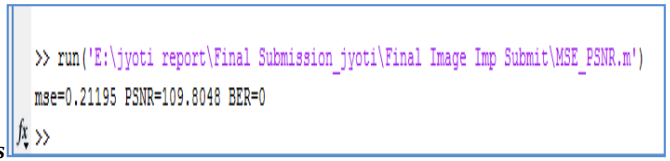


Fig 15: Error rate values

a. Audio files samples using text watermarking

Audio file	MSE	PSNR	BER
Rani.wav	0.21195	109.8049	0
Tuhi.wav	0.17548	111.4448	0

Yarri.wav	0.20466	110.1088	0
Imran.wav	0.19562	110.5012	0
Min.wav	0.24311	108.6135	0
Seec.wav	0.28389	107.2666	0

TABLE 1: Audio files samples using text watermarking

The PSNR of all Audio samples is above 107 dB as shown in Table 1, establishing good imperceptibility. The minimum value obtained for PSNR using the proposed algorithm is 107.2666dB for Seec.wav audio and maximum is 111.4448dB for Tuhi.wav audio. This indicates that the proposed algorithm is perceptually transparent.

It can be seen from audio sample results that proposed algorithm has better performance in terms of payload capacity and robust. The algorithm presented has a very high payload capacity. This table showed 0 % BER for any type of audio signal against .wav file.

b. Audio file samples using Image watermarking

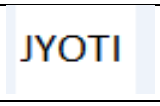
Audio file	MSE	PSNR	BER
Rani.wav	0.21195	109.8048	0
Tuhi.wav	0.17548	111.4447	0
Yarri.wav	0.20466	110.1087	0
Imran.wav	0.19562	110.5011	0
Min.wav	0.24311	108.6135	0
Seec.wav	0.28389	107.2665	0

TABLE 2: Audio file samples using Image watermarking

The PSNR of all Audio samples is above 107 dB as shown in Table 2, establishing good imperceptibility. The minimum value obtained for PSNR using the proposed algorithm is 107.2665dB for Seec.wav audio and maximum is 111.444dB for Tuhi.wav audio. This indicates that the proposed algorithm is perceptually transparent. The BER for all audio samples are 0.

c. Comparison between DCT on Text Image & Text

In proposed work we take two type of watermark first is Text watermark and second is Text Image watermark. We compare the results of these two watermarks. The comparison and implementation of comparison is shown below:

S. No	Comparison	Text watermark	Image watermark
1	Example Of watermark	Jyoti	
2	Processing time	Processing time is less when watermark is in text form	Processing time is more when watermark is in image form
3	Graph	Graph Before and after adding watermark never change	There is difference between before and after watermark.

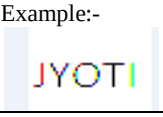
4	Output	When extracting watermark the text is same as programmer insert. Example :- jyoti	When extracting watermark the image loss some pixel during extraction and its color get changed. Example:- 
5	Size of watermark	No restriction on text. The user takes any size of text.	The size of image matter. Increase size will take more processing time.

TABLE 3: Comparison between watermarks

CONCLUSION

The PSNR of all Audio samples is above 107 dB as shown in Table 1 and table 2, establishing good imperceptibility. The minimum value obtained for PSNR using the proposed algorithm is 107.266dB for Seec.wav audio and maximum is 111.444dB for Tuhi.wav audio. This indicates that the proposed algorithm is perceptually transparent.

In referred research paper "A High Payload Audio Watermarking Algorithm Robust against Mp3 Compression by Arashdeep Kaur, K.M.Soni and Nidhi Taneja [13]". DWT technique was applied on Text Image watermark and the results were:

Audio Sample	SNR in dB
Blues1	40.3883
Pop1	44.2879
Folk1	42.5505
Country1	41.5105
Classical1	33.1806

TABLE 4: SNR Values

In proposed work we applied DCT and the watermark is Text image and text. The PSNR values are:

Audio file	MSE	PSNR	BER
Rani.wav	0.21195	109.8048	0
Tuhi.wav	0.17548	111.4447	0
Yarri.wav	0.20466	110.1087	0
Imran.wav	0.19562	110.5011	0
Min.wav	0.24311	108.6135	0
Seec.wav	0.28389	107.2665	0

TABLE 3: Audio file samples using Image watermarking

From the above table it can be concluded that our work is going to reduce the error and signal to noise ratio is better than referred work. But we further applied text as a watermark instead of text image so that the image processing time can be reduced further and proper text can be extracted later.

It can be seen from audio sample results that proposed algorithm has better performance in terms of payload capacity and robust. The algorithm presented has a very high payload capacity. This table showed 0 % BER for any type of audio signal against .wav file.

The proposed algorithm is said to balance the two conflicting design requirements i.e. imperceptibility and robustness. Hence, using audio sample results it is verified that the proposed watermarking algorithm balance the three contradictory design requirements imperceptibility, payload and robustness.

In proposed work we took two type of watermark first is text watermark and second is image watermark.
It can be seen from audio samples that when we send the image as a watermark the processing time is more than the text watermark. When we extract the image watermark the quality of image is not the same as we insert .Some pixel values are destroyed during extraction process. So sending of text as watermark is quite better and more reliable way.

FUTURE SCOPE

- In future we will try to reduce mean squared error (MSE) value.
- It will be tried to embed audio signals as a watermark rather than text watermark or image watermark.
- In future we will try to improve the quality of image watermark.
- In future we will try to improve the PSNR value.

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[12] http://sites.stat.psu.edu/~lsimon/stat501wc/sp05/01simple/05simple_sigma2.html
[13] http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=6897229&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D6897229